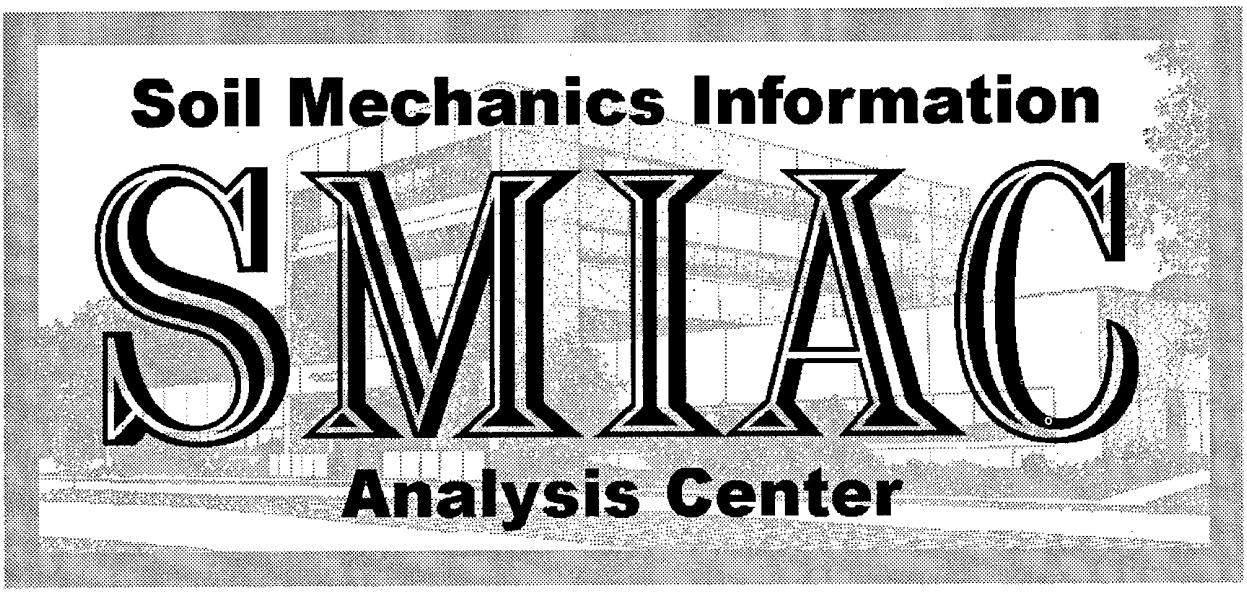

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Dual Use Technologies

The U.S. Army Corps of Engineers has been instrumental in developing technologies in the soil mechanics field that have application in both the civilian and military arenas. The two articles presented in this newsletter are ongoing military research and development initiatives under the Army's Vehicle-Terrain Interaction Program. This program is concerned with the modeling and prediction of military ground vehicle mobility performance worldwide. However, when completed, civilian applications would include, but not be limited to, the planning and execution of logging operations, fire-breaks, aircraft crash rescue operations, counterdrug operations, and emergency evacuation operations. The U.S. Departments of Agriculture, Interior, Justice, and Transportation have already seen limited use of this research.

In This Issue

Soil Moisture Modeling and Prediction

The strength or bearing capacity of the soil is a vital terrain descriptor necessary to predict the performance of ground vehicle mobility models. The U.S. Army Engineer Waterways Experiment Station (WES) Geotechnical Laboratory has recently developed a theoretical model for predicting soil moisture and soil strength. The Soil Moisture Strength Prediction Model (SMSP II) is based on research conducted at WES beginning in the early 70's to predict soil strength based upon precipitation data and Unified Soil Classification System (USCS) soil type, studies conducted in the mid-80's by P. J. Sellers and Y. Mintz, and on-going research at WES. Sellers' and Mintz's work provided a more theoretical basis for the estimation of soil moisture rather than the accretion and depletion relationships empirically derived in the 70's.

The most recent development of SMSP II was to extend the predictive capability of SMSP II to worldwide application. The model had used empirically derived accretion and depletion relationships, developed through years of field measurements for a variety of USCS soil types and wetness conditions, to predict soil moisture and related soil strength. In order to extend the predictive capability of SMSP to worldwide application, a new methodology had to be developed. The studies conducted by Sellers and Mintz have provided a theoretical basis for the estimation of soil moisture. Basically, power curves representing the relationships between suction pressure head, hydraulic conductivity, and volumetric water content are employed to model water transfer among soil layers. Water loss is calculated as a function of evaporation, root absorption, capillary action, and runoff. This methodology, which requires a detailed quantitative data set, has been modified for application on a macro-level global scale.

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Spatio-Temporal Modeling of Soil Strength

Research at WES to simulate accurate variations in spatial and temporal changes in soil strength is on-going. Forecasting variations in surface soil strengths with regard to time and space can provide a continuous mapping of the inherent heterogeneity of soil material. Understanding such variability provides information on risk of failure of a structure over time or accurate prediction of soil and tire/track interaction of ground vehicles.

The temporal algorithms are built upon the physical characteristics of the soil and are sensitive to weather and climatic changes. Forecasting changes in soil strength is useful in predicting vehicle mobility. This capability is not currently available in the mobility models.

The spatial algorithms will provide high resolution soil data when only sparse data are available. WES is developing a theory to implement the spatial algorithms, using a multi-variate form of kriging, with temporal algorithms, using a modified form of a Box Jenkins approach. The theory extends the current soil moisture/strength predictions (SMSP II) to provide high resolution characterization and accuracy of predictions for a given surface. Accurate predictions of soil strength changes with time and space will provide information relative to risk of immobilization and will provide analysts with both short- and long-term operational planning tools.

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A Department of the Army Information Analysis Center

The *SMIAC Bulletin* is published and distributed periodically. Please contact the Director of SMIAC for more information: Director, Soil Mechanics Information Analysis Center, U.S. Army Engineer Waterways Experiment Station, ATTN: CEWES-GV-Z, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, Phone: (601) 634-3376, Fax: (601) 634-3139. Visit the SMIAC Bulletin URL *http://www.wes.army.mil/GL/SMIAC/smiac.html.*

Upcoming Geotechnical Event

The newly formed ASCE Geo-Institute (formally known as Geotechnical Division) is jointly sponsoring **IN SITU REMEDIATION OF THE GEOENVIRONMENT** with the Environmental Engineering Division in Minneapolis, MN, on October 5-7, 1997. The conference will focus on the analysis, design, modeling, construction, and performance of in situ systems for the remediation of the subsurface environment. In Situ Remediation '97 will bring together leaders from consulting, government, academia, and construction. These individuals and other participants will present a variety of technical solutions for the challenging problems of in situ remediation of the contaminated soil and groundwater. For more information contact

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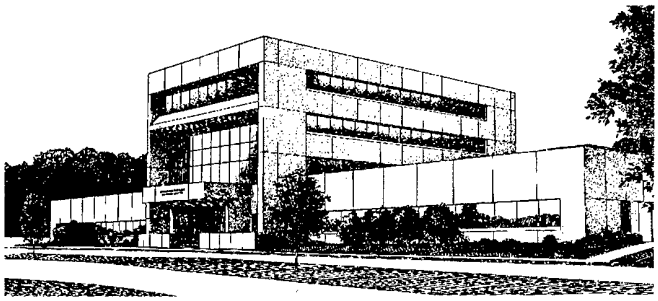
Recent Patent Licensing Activities

Computer Controlled Microwave Oven for Water Content Determination, Patent No. 5,085,527, issued Feb. 4, 1992. Army approved manufacturing license (non-exclusive) to Durham on June 4, 1996.

Expandable Sand Grids, Patent No. 4,797,026, issued Jan. 10, 1989. Army approved manufacturing license (non-exclusive) to AGH on June 4, 1996.

Dual Mass Dynamic Cone Penetrometer, Patent No. 5,313,825, issued on May 24, 1994. Army approved manufacturing license (non-exclusive) to Kessler, GeoTec, and Salem on June 14, 1996.

For a listing of WES publications related to soil mechanics via the Internet, access the URL *http://libwes.wes.army.mil/index.htm*.



US Army Corps of Engineers
Waterways Experiment Station

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